Listing of Claims

This listing of claims supersedes all previous listings of claims.

What is Claimed:

1. (Canceled)

2. (Previously presented) The fuel cell according to claim 62, wherein the hydrocarbon is a petroleum distillate.

3. (Previously presented) The fuel cell according to claim 2, wherein the petroleum distillate is selected from the group consisting of gasoline, diesel oil, naphtha, JP-4, JP-5, JP-8, kerosene, motor oil, natural gas, fuel oil, and mixtures thereof.

4. (Previously presented) The fuel cell according to claim 3, wherein the petroleum distillate is selected from the group consisting of JP-4, JP-5, JP-8, and mixtures thereof.

5. (Previously presented) The fuel cell according to claim 3, wherein the petroleum distillate is selected from the group consisting of naptha, kerosene, fuel oil, and mixtures thereof.

6. (Previously presented) The fuel cell according to claim 3, wherein the petroleum distillate is selected from the group consisting of gasoline, diesel oil, natural gas, and mixtures thereof.

7. (Original) The fuel cell according to claim 2, wherein the hydrocarbon comprises an alcohol.

8. (Previously presented) The fuel cell according to claim 7, wherein the alcohol is selected from the group consisting of methanol, ethanol, and mixtures thereof.

9. (Currently amended) The fuel cell according to claim 2, wherein the hydrocarbon is

selected from the group consisting of ~~dry methane~~, butane, toluene, decane, and mixtures thereof.

10. (Previously presented) The fuel cell according to claim 62, wherein the sulfur containing hydrocarbon fuel has a sulfur content of from about 1 ppm to about 1000 ppm.

11. (Currently Amended) The fuel cell according to claim 10, wherein the sulfur-containing hydrocarbon fuel has a sulfur content of from about 10 ~~pprn~~ ppm to about 1000 ppm.

12. (Currently Amended) The fuel cell according to claim 11, wherein the sulfur-containing hydrocarbon fuel has a sulfur content of from about 20 ~~pprn~~ ppm to about 1000 ppm.

13. (Currently Amended) The fuel cell according to claim 12, wherein the sulfur-containing hydrocarbon fuel has a sulfur content of from about 100 ~~pprn~~ ppm to about 1000 ppm.

14. (Currently Amended) The fuel cell according to claim 13, wherein the sulfur-containing hydrocarbon fuel has a sulfur content of from about 250 ~~pprn~~ ppm to about 1000 ppm.

15. (Currently amended) The fuel cell system according to claim [[4]] 62, wherein the solid electrolyte is an oxide ion conducting material.

16. (Previously presented) The fuel cell according to claim 15, wherein the oxide ion conducting material is selected from the group consisting of doped ceria, doped zirconia, and doped lanthanum gallate.

17. (Previously presented) The fuel cell according to claim 16, wherein the doped ceria is selected from the group consisting of gadolinium doped ceria, samarium-doped ceria, yttria-doped ceria, and mixtures thereof.

18. (Previously presented) The fuel cell according to claim 15, wherein the oxide ion conducting material is yttria-doped zirconia.

19. (Previously presented) The fuel cell according to claim 16, wherein the doped zirconia is scandium-doped zirconia.

20. (Canceled)

21 (Previously presented) The process according to claim 63, wherein the hydrocarbon is a petroleum distillate.

22. (Previously presented) The process according to claim 21, wherein the petroleum distillate is selected from the group consisting of gasoline, diesel oil, naphtha, JP-4, JP-5, JP-8, kerosene, motor oil, natural gas, fuel oil, and mixtures thereof.

23. (Previously presented) The process according to claim 22, wherein the petroleum distillate is selected from the group consisting of JP-4, JP-5, JP-8, and mixtures thereof.

24. (Previously presented) The process according to claim 22, wherein the petroleum distillate is selected from the group consisting of naphtha, kerosene, fuel oil, and mixtures thereof.

25. (Original) The process according to claim 22, wherein the petroleum distillate comprises gasoline.

26. (Original) The process according to claim 22, wherein the petroleum distillate comprises diesel oil.

27. (Currently amended) The process according to claim 63, wherein the hydrocarbon is selected from the group consisting of alcohols, ~~dry methanes~~, butane, toluene, decane, and mixtures thereof.

28. (Original) The process according to claim 27, wherein the hydrocarbon comprises an

alcohol.

29. (Previously presented) The process according to claim 28, wherein the alcohol is selected from the group consisting of methanol, ethanol, and mixtures thereof.

30. (Previously presented) The process according to claim 63, wherein the sulfur containing hydrocarbon has a sulfur content of from about 10 ppm to about 1000 ppm.

31 .-53. (Canceled without prejudice)

54. (Canceled)

55. (Currently amended) The fuel cell system of claim 62, wherein the anode further comprises copper deposited in the pores.

56. (Previously presented) The process of claim 63, wherein the anode further comprises copper deposited in the pores.

57. (Canceled)

58. (Currently amended) The fuel cell system of claim 64[5], wherein the anode further comprises copper deposited in the pores.

59. (Canceled)

60. (Previously presented) The process of claim 66, wherein the anode further comprises copper deposited in the pores.

61. (Canceled)

62. (Currently amended) A solid oxide fuel cell system capable of directly operating[es] with a sulfur-containing hydrocarbon fuel that does not ~~have to~~ undergo prior treatment to remove organic sulfur compounds, comprising:

(a) a solid electrolyte comprising an electronic insulator that ~~which~~ allows transfer of anions;

(b) an essentially nickel-free porous anode containing at least ceria deposited in the pores, the anode further comprising a ceramic, and at least a portion of the anode being bound to the electrolyte;

(c) a cathode;

(d) a fuel comprising a ~~sulfur-containing~~ hydrocarbon having 2 or more carbons, and the fuel being characterized as having a sulfur content of from about 1 ppm to about 5000 ppm; and

(e) an oxygen source;

~~wherein at least the solid electrolyte and porous anode form a porous anode layer and a dense solid electrolyte layer, wherein like particles of the porous anode and the solid electrolyte are bonded together, the porous anode layer comprising a porous ceramic and further deposited with at least ceria to form a porous anode with at least ceria deposited in the pores~~

wherein the solid electrolyte and the porous anode overlap one another so as to define a region of physical contact between one another, the region of physical contact being characterized as an essentially uninterrupted interface.~~in physical contact with one another, and essentially the entirety of the physical contact between the solid electrolyte and the porous anode comprising physical contact between the solid electrolyte and the porous ceramic of the composite anode.~~

63. (Currently amended) A process of producing electrical energy, comprising:

(a) providing a solid oxide fuel cell system capable of ~~that~~ directly operating[es] with a sulfur-containing hydrocarbon fuel that does not ~~have to~~ undergo prior treatment to remove organic sulfur compounds, the solid oxide fuel cell system comprising:

a solid oxide electrolyte comprising ~~that is~~ an electronic insulator that ~~which~~ allows transfer of anions;

an essentially nickel-free porous anode containing at least ceria deposited in the pores, the anode further comprising a ~~and comprising a porous~~ ceramic, and at least a portion of the anode being secured to the electrolyte; and

a cathode, and

a fuel comprising a hydrocarbon having two or more carbons, and the fuel being characterized as having a sulfur content of from about 1 ppm to about 5000 ppm,

~~wherein at least the solid oxide electrolyte and porous anode form a porous anode layer and a dense solid electrolyte layer, wherein like particles of the porous anode and the solid electrolyte are bonded together prior to depositing at least ceria into the pores of the anode to form a porous anode with at least ceria deposited in the pores~~ wherein the solid electrolyte and the anode overlap one another so as to define a region of physical contact between one another, the region of physical contact being characterized as an essentially uninterrupted interface,

~~in physical contact with one another,~~

~~essentially the entirety of the physical contact between the solid electrolyte and the porous anode comprising physical contact between the solid electrolyte and the porous ceramic of the composite anode;~~

(b) contacting the ~~said~~ cathode with an oxygen source; and

(c) contacting the ~~said~~ porous anode with the [a] fuel. ~~comprising a sulfur-containing hydrocarbon having a sulfur content of from about 1 ppm to about 5000 ppm.~~

64. (Currently amended) A solid oxide fuel cell system capable of directly operating[es] with a sulfur-containing hydrocarbon fuel that does not ~~have to~~ undergo prior treatment to remove organic sulfur compounds, comprising:

(a) a solid electrolyte comprising an electronic insulator that ~~which~~ allows transfer of anions;

(b) an essentially nickel-free porous anode containing at least ceria deposited in the pores, the anode further comprising a ceramic, and at least a portion of the anode being bound to the electrolyte;

(c) a cathode;

(d) a fuel comprising a ~~sulfur-containing~~ hydrocarbon having 2 or more carbons, and the fuel being characterized as having a sulfur content of from about 1 ppm to about 5000 ppm; and

(e) an oxygen source;

~~wherein at least the solid electrolyte and porous anode form a porous anode layer and a dense solid electrolyte layer, wherein like particles of the porous anode and the solid electrolyte are bonded together, the porous anode layer comprising a porous ceramic and further deposited with at least ceria to form a porous anode with at least ceria deposited in the pores~~

wherein the solid electrolyte and the porous anode overlap one another so as to define a region of physical contact between one another, the region of physical contact being characterized as an essentially uninterrupted interface.~~in physical contact with one another, and essentially the entirety of the physical contact between the solid electrolyte and the porous anode comprising physical contact between the solid electrolyte and the porous ceramic of the composite anode.~~

65. (Canceled) A solid oxide fuel cell that directly operates with a sulfur-containing hydrocarbon fuel comprising:

(a) a solid electrolyte comprised of an electronic insulator which allows transfer of anions; an essentially nickel-free porous anode containing at least ceria deposited in the pores; and a cathode;

(b) a fuel comprising a sulfur-containing hydrocarbon having a sulfur content of from about 1 ppm to about 5000 ppm; and

(c) an oxygen source;

wherein like particles of the porous anode and the solid electrolyte are bonded together, and wherein the porous anode layer and solid electrolyte contact one another along an essentially continuous interface..

66. (Currently amended) A process of producing electrical energy, comprising:

(a) providing a solid oxide fuel cell system capable of ~~that~~ directly operating[es] with a sulfur-containing hydrocarbon fuel, the solid oxide fuel cell comprising

a solid oxide electrolyte that is an electronic insulator that ~~which~~ allows transfer of anions,[;]

an essentially nickel-free porous anode, the anode further comprising a ceramic, the anode containing at least ceria deposited in the pores and comprising a porous ceramic, and at least a portion of the anode being bound to the electrolyte[;] and

a cathode,

(b) contacting said cathode with an oxygen source; and

(c) contacting said porous anode with a fuel comprising a ~~sulfur-containing~~ hydrocarbon having two or more carbons, the fuel being characterized as having a sulfur content of from about 1 ppm to about 5000 ppm,

wherein the solid electrolyte and the porous anode overlap one another so as to define a region of physical contact between one another, the region of physical contact being characterized as an essentially uninterrupted interface.

~~the solid oxide electrolyte and the porous anode being in physical contact with one another,~~

~~essentially the entirety of the physical contact between the solid electrolyte and the composite anode comprising physical contact between the solid electrolyte and the porous ceramic of the composite anode.~~

67. (Canceled) A solid oxide fuel cell that directly operates with a sulfur-containing hydrocarbon
fuel comprising:

(a) a solid electrolyte comprising an electronic insulator which allows transfer of anions; an essentially nickel-free porous ceramic-metal composite anode containing at least copper deposited in the pores; and a cathode;

(b) a fuel comprising a sulfur-containing hydrocarbon having a sulfur content of from about 1 ppm to about 5000 ppm; and

(c) an oxygen source;

wherein like particles of the porous anode and the solid electrolyte are bonded together, and wherein the porous anode layer and solid electrolyte contact one another along an essentially continuous interface.